

Revealing the correlation between hatching weight and egg characteristics in Tukong chickens

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Abstract. The Tukong chicken, renowned for its unique rumpless trait, is indigenous to West Kalimantan, Indonesia. This study endeavors to explore the intricate associations among hatching weight, egg weight, and egg index within the Tukong chicken breed. A total of 104 Tukong chicken eggs served as the primary research material, sourced from 10 female hens paired with 5 male counterparts. To ensure consistent data, the chickens were reared under uniform conditions and management practices. The parameters examined encompassed hatching weight, egg weight, egg length, egg width, and egg index. Comprehensive data analysis, including descriptive and correlation analyses employing SPSS version 25 software, unveiled specific metrics for the Tukong chickens in these dimensions: hatching weight (31.09 ± 2.47 g), egg weight (42.65 ± 4.59 g), egg length (49.84 ± 2.33 mm), egg width (38.84 ± 1.96 mm), and egg index ($78.04 \pm 4.55\%$). Noteworthy findings include a robust and statistically significant positive correlation ($p < 0.01$) between hatching weight and egg weight ($r = 0.758$), egg length ($r = 0.495$), and egg width ($r = 0.522$). However, no significant correlation emerged between egg index and either egg weight or hatching weight. In conclusion, this research contributes valuable insights into the complex relationships governing hatching weight and various egg attributes in Tukong chickens. These findings promise to enhance egg quality and optimize hatching outcomes within Tukong chicken breeding programs.

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1 Introduction

Indonesia boasts a rich repository of local chicken germplasm, which plays a pivotal role in bolstering economic resilience and national stability [1]. These indigenous chicken populations exhibit a blend of specific and non-specific characteristics coupled with unique morphological traits [2]. Specific local chicken breeds are characterized by distinct attributes, such as feather color or body shape, setting them apart from other breeds. One such remarkable example is the Tukong chicken, which hails from West Kalimantan and is renowned for its distinctive feature, the absence of a tailbone, rendering it rumpless [3]. Despite its uniqueness, the Tukong chicken remains a rare gem within Indonesia's local poultry landscape, meriting further investigation due to its limited population and dearth of production data.

Local chickens hold profound significance for rural communities as vital sources of animal protein, supplying both meat and eggs to satisfy dietary requirements [4,5]. Nonetheless, the relatively low production performance of these indigenous breeds poses a substantial challenge to their widespread adoption. Various strategies, including selective breeding, have been employed to enhance their productivity [6]. The criteria for selection encompass pivotal factors such as egg weight, egg size, and day-old chick (DOC) weight. Notably, the selection of high-quality eggs at the point of hatching assumes paramount importance in ensuring the production of healthy chicks.

Evidently, a robust correlation exists between egg weight and hatching weight in chickens. Egg weight exerts a direct influence on hatchability, embryo viability, hatching weight, and, by extension, the subsequent production of chicks [7–9]. In light of these considerations, this research endeavors to elucidate the relationship between egg weight, the egg index, and hatching weight in Tukong chickens. The outcomes of this analysis are poised to furnish valuable insights and guidelines for elevating the productivity of these unique local chickens, contributing to the broader goal of sustainable poultry farming in Indonesia.

2 Materials and methods

In this research, we utilized a total of 104 Tukong chicken eggs as our primary research material. These eggs were sourced from 10 female Tukong chickens, carefully matched with 5 male Tukong counterparts. The selected local breeds ranged in age from 8 to 12 months. To facilitate their well-being and maximize reproductive success, we accommodated these chickens in five flock cages. Each cage measured 1.5 x 2 meters, maintaining a mating ratio of 1:2. Adequate provisions were made for their nourishment and nesting requirements, including feeders, drinkers, and nesting spaces for egg-laying. Our chickens were fed a formulated diet twice daily (morning and evening) with the following composition: dry matter content at 89.21%, crude protein at 14.22%, crude fiber at 8.08%, and crude fat at 7.05%. Access to clean drinking water was provided ad libitum throughout the entire research period.

The tools employed in this study comprised calipers and electric scales. The research process consisted of three distinct stages: preparation, implementation, and data analysis. The preparation stage encompassed pre-research activities, which included the procurement of essential tools and materials. The implementation stage involved the collection of eggs and the natural incubation process for Tukong chicken eggs. The parameters under scrutiny in this study included egg weight, egg length, egg width, egg index, and hatching weight. Egg length and width were measured using calipers, while egg weight and hatching weight were determined using an electric scale. Hatching weight was ascertained by weighing the chick after its feathers had fully dried. The egg index was calculated by dividing the egg width by

the egg length, multiplied by 100% [10]. The data collected were subjected to descriptive analysis and correlation analysis [11], performed using SPSS version 25 software.

3 Results and discussion

The descriptive analysis of egg measurements and hatching weight for Tukong chickens is presented in Table 1. In our study, the average egg weight was recorded at 42.65 ± 4.59 grams, accompanied by an egg index of $78.04 \pm 4.55\%$. The observed egg weight for Tukong chickens in this study falls within the "normal" range, comparable to that of Kedu chickens in the small category, which exhibit an average egg weight of 42 grams [12]. In contrast, Kedu Red Combed chickens typically demonstrate a wider egg weight range, spanning from 45.80 to 47.14 grams [13]. Meanwhile, for Kedu Black chickens, the average egg weight varies throughout their development, with an initial period weight of 28.64 grams, reaching 35.69 grams at peak production, and stabilizing at 43.44 grams in parent hens aged 52 weeks [14]. It's important to note that the egg weight in our study also diverges from that of various other chicken breeds, including Kampung chickens (38.1 grams), Nunukan chickens (47.3 grams), Pelung chickens (47.6 grams), Gaok chickens (46.7 grams), Hubbard Classic chickens (ranging from 60.05 to 70.03 grams), Broiler chickens (40-60 grams), Nigerian local strain (41 grams), and Tswana chickens (with a range of 41.32 to 49.79 grams) [14–18]. These variations in egg weight can be attributed to a multitude of factors, such as breed, body weight, and age [19].

Table 1. Descriptive analysis of hatching weight and egg measurements

Traits	Minimum	Maximum	Mean	Standard Deviation
Hatching weight (g)	25.00	36.00	31.09	2.47
Egg weight (g)	32.00	52.00	42.65	4.59
Egg length (mm)	42.42	54.49	49.84	2.33
Egg width (mm)	27.95	47.73	38.84	1.96
Egg index (%)	52.19	95.31	78.04	4.55

In this study, the Tukong chicken egg index was calculated to be $78.04 \pm 4.55\%$ (Table 1). The egg index serves as a vital metric for characterizing egg shape, with a higher value indicating a rounder egg, while a lower value signifies a more oval shape. Accurate determination of egg geometric parameters holds significant importance across various applications, encompassing egg processing, handling, transportation, and production forecasting. The egg index, as a general geometric descriptor, aids in categorizing eggs into sharp, normal (standard), or round shapes, with corresponding egg index values below 72%, between 72-76%, and above 76%, respectively [20]. Comparing our findings with those of other studies reveals interesting insights. The egg index of Tukong chickens in our study surpassed the reported index for eggs of Arab chickens, Local chickens, and Ketarra chickens, which stood at $76.53 \pm 3.03\%$, $74.34 \pm 3.63\%$, and $77.63 \pm 6.37\%$, respectively [21]. Conversely, it closely resembled the egg index of Superbrown layer chickens (78.08%) [20].

Moving on to the hatching weight of Tukong chickens in our study, we observed an average weight of 31.09±2.47 grams. When compared to other poultry breeds, the hatching weight of Tukong chickens falls within a distinct range. It exceeds the hatching weight of Kedu Red Combed chickens, which typically ranges from 30.33 to 30.92 grams [13], but remains lower than that of broiler chickens, which can range from 38.58 to 45.50 grams [9]. It's important to note that the relatively lower hatching weight in Tukong chickens can be attributed to their comparatively lower adult body weight. This, in turn, has an impact on both egg weight and hatching weight [3,22]. Furthermore, variations in egg weight and size, as well as chicken hatching weight, can be influenced by a multitude of factors including breed, rearing system, parent age, and diet [10]. These findings underscore the complexity of poultry biology and production, highlighting the importance of considering multiple factors when interpreting results and making informed decisions in the poultry industry.

Table 2. Pearson correlations (below diagonal) and its significance (above diagonal) between hatching weight and egg measurements

Traits	Hatching weight	Egg weight	Egg length	Egg width	Egg index
Hatching weight		**	**	**	Ns
Egg weight	0.758		**	**	Ns
Egg length	0.495	0.691		**	**
Egg width	0.522	0.687	0.279		**
Egg index	0.072	0.046	-0.577	0.620	

Note: Ns: Non-significant, **: significant at $p < 0.01$ level

The correlation analysis conducted in this study, as summarized in Table 2, unveils several noteworthy associations between hatching weight and various egg characteristics in Tukong chickens. Notably, a positive correlation with a strong statistical significance ($r=0.758$, $p < 0.01$) was observed between hatching weight and Tukong chicken egg weight. Similarly, positive and significant correlations ($p < 0.01$) were identified between hatching weight and egg weight, as well as between hatching weight and the egg's linear dimensions, including egg length and egg width. These findings highlight the integral relationship between hatching weight and these critical egg attributes.

On the other hand, the egg index, representing the egg's shape, exhibited no significant correlation ($p > 0.05$) with either egg weight ($r=0.046$) or hatching weight ($r=0.072$), with both correlation coefficients indicating a relatively weak association. It is worth noting that the egg shape index, defined as the ratio of egg width to length, holds significance in determining egg orientation during incubation and the embryo's mobility for efficient nutrient utilization. This observed weak correlation aligns with previous research conducted on Nigerian Indigenous chickens [23] and Tswana chickens [18], which also reported limited associations between egg weight and egg shape index.

The findings of our study reveal a positive, strong, and statistically significant correlation between egg characteristics and hatching weight in Tukong chickens. This outcome is consistent with research conducted on various other poultry breeds, including chickens [9,24], ducks [10], turkeys [25], and geese [26]. These collective results suggest that an

increase in egg weight directly corresponds to an increase in hatching weight, indicating a proportional relationship. This correlation underscores the significance of hatching egg weight in the context of egg incubation, as it significantly influences the economic aspects of poultry farming [10,27].

However, it's important to note that while egg weight and hatching weight are closely correlated, their impact on post-hatching growth and eventual adult chick weight may vary. Egg size, particularly in terms of larger eggs, plays a pivotal role in chick performance, potentially leading to larger chicks compared to those hatched from smaller eggs [9,28]. These findings emphasize the multifaceted interplay between egg characteristics and hatching outcomes, which should be considered when optimizing poultry production strategies.

4 Conclusion

In conclusion, our study sheds light on the relationships between Tukong chicken egg attributes and hatching weight, offering valuable insights for poultry producers aiming to enhance egg quality and optimize hatching outcomes in Tukong chicken breeding programs. Further research can build upon these findings to explore additional factors influencing egg characteristics and their impact on overall poultry production.

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